Title: Your Local Pond: "A Delicate Aquatic Biome"

Brief Overview:

In most communities there is a delicate balance between living organisms and abiotic factors. When man disturbs that balance by altering the abiotic factors, the results are usually detrimental. In this unit the basic biology of living organisms will be challenged by chemicals introduced by man. The students should be able to connect basic concepts such as eutrophication, dissolved oxygen and man's societal role in maintaining a balance. They will determine the effects of phosphate concentration on algae growth.

Links to NCTM Standards:

- **Mathematics as Problem Solving**
  Given measured amounts of phosphate, students will determine the affects of phosphate on algae growth by extrapolating the amount of algae present via ratios and proportion problems.

- **Mathematics as Communication**
  Based on collected data, graphs will be constructed which will illustrate the correlation between phosphate and algae growth.

- **Patterns and Functions**
  Based on graphed information, the students will be able to, via linear regressions (best fit curves) predict future outcomes.

Grade/Level:

Grades 7 and 8

Duration/Length:

Three (3) fifty-five minute periods

Prerequisite Knowledge:

The students should have a basis knowledge of biological principles, to include eutrophication, anaerobic, and anaerobic bacteria. They should also be familiar with the operations of a microscope. Students should know the origin and effect of phosphates on nutrient systems. They should also be familiar with preparing a line graph. An optional lesson on how to use graphing software for curve fitting would be appropriate.

Objectives:

Students will:

- discover how to make measurements of microscopic organisms.
- be able to analyze the relationship of abiotic factors to living communities.
- be able to relate the outcomes to real-life situations.
  be able to graph collected data by hand (optionally graphing using a graphing calculator and software)

Materials/Resources/Printed Materials:

- Microscope
- Grid scale
- 6 - 1 liter flasks per group
- Source for phosphates (detergent, etc.)
- Titrator or pipet
- Algae (may be supplied by pond water)
- Graphing materials
- Grow light (optional)
- Graphing calculator (optional)

Development/Procedures:

- Set up a lab with equal volumes of algae in groups of four students. (Amounts to be assigned by teacher)
- Place a specified amount of phosphate in each flask. (Amount to be specified by teacher) The control has no phosphate added.
- Use a microscope to measure the amounts of algae at the end of the prescribed time.
- Collect qualitative data for four days.
- Collect quantitative data on the fourth day.
- Graph the quantitative data.

Performance Assessment:

Teachers will be able to assess a student's understanding by:

- evaluating the graphing format.
- comparing algae counts of various groups.
- evaluating oral presentations of scientific or student findings.
- evaluating pen/paper quizzes on the relationship of biological information to collected data.

Extension/Follow Up:

- Allow the experiment to continue for ten more days, and periodically collect data to determine a continued pattern.
- Substitute other nutrients for phosphate, i.e. nitrates
- Show a correlation between dissolved oxygen and algae growth.
- Research current and past government policies relating to the control of phosphate and nitrate nutrients as well as water quality in general.

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BIOME LAB WORKSHEET

TITLE: The Effects of Phosphate Concentration on Algae.

PURPOSE: To investigate the correlation between the amount of algae produced by the addition of phosphates to pond water.

MATERIALS: (6) one liter flasks, phosphate solutions, microscope, graphing materials

PROCEDURE:

1. Label (6) one liter flasks A - F.
2. Place 1 L of pond water into each flask. Confirm presence of bacteria and algae with a microscope.
3. Add the following amounts of phosphate to the assigned flasks:
   Flask A - 0 mg/L
   " B - 0.50
   " C - 1.00
   " D - 2.00
   " E - 4.00
   " F - 8.00
4. Place each flask under a grow light or in an area where it can receive an adequate amount of sunlight.
5. Allow the algae to set for four days.
6. Measure the algae in each flask. (See note 3)
   Record qualitative and quantitative observations.
7. Graph group and class data. Algae vs. Phosphate

TEACHER'S GUIDE

Experimental Design

INDEPENDENT VARIABLE - **PHOSPHATE CONCENTRATION (PO_4^{-3})**

	0 mg/L	0.50	1.00	2.00	4.00	8.00
Algae Cell/L						

DEPENDENT VARIABLE: AMOUNT OF ALGAE
CONSTANTS: TEMPERATURE, AMOUNT OF SUNLIGHT, VOLUME OF WATER, ETC.
CONTROL: 0 mg/L PHOSPHATE

NOTE 1.

Setting up equal amounts of algae: The pond water will contain different types of algae, however the various types will not be a factor because equal amounts can be achieved by thoroughly mixing the initial collection vessel just prior to dispensing. Algae can be observed in a drop of water under a microscope.

If using commercial algae and aerobic bacteria, place the algae stock in 500 mL of dechlorinated water. Take 20 mL of this mixture (after thorough agitation) and add it to 1 liter of dechlorinated water.

NOTE 2:

During the four-day wait, the teacher should discuss the inhabitants of a pond community. Have the students diagram different food chains within the pond. Show how each food chain could be affected by the conditions of eutrophication and algal blooms. The most common affect would be the ultimate using up of dissolved oxygen, therefore, fish and other oxygen consuming organisms would suffer. Another effect could be the explosive growth of algae over the surface of the pond that could block the sunlight needed by photosynthesizing organisms. Review the equations for photosynthesis and cellular respiration as they relate to this situation. Also discuss the source of the nutrients (farm fertilizer and household products, etc.) and how these sources can be changed. The teacher should stimulate discussion of the rights and responsibilities of all parties that could impact on water quality. Invite discussion on how negative impacts on water quality will ultimately affect all consumers.

NOTE 3:

Measuring algae with a microscope:
The students will have to mix the solution thoroughly. The students will place measured drops of water/algae on a grid slide. If you do not have grid slides, attach regular graph paper under a clear slide. The students will then have to count the algae found per box. This will give you the amount of algae for that measured drop of water. Set up a proportion to determine the approximate amount of algae per flask, i.e. if your count is 121 algae cells in 0.5 mL of water, you can then set up a proportion of:

121 cells/0.5 mL = x cells/1000 mL = 60,500 algae cells

NOTE 4:

The teacher may want to leave the flask and contents in order to do further readings.

DATA TABLE

Phosphate mg/L	Algae Cells/L Trial 1	Algae Cells/L Trial 2	Algae Cells/L Trial 3	Algae Cells/L Average
0				
0.50				
1.00				
2.00				
4.00				
8.00				